

Irradiation Facilities of JRR-3 , JRR-4 and NSRR

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- JRR-3
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- NSRR

JRR-3

JRR-4

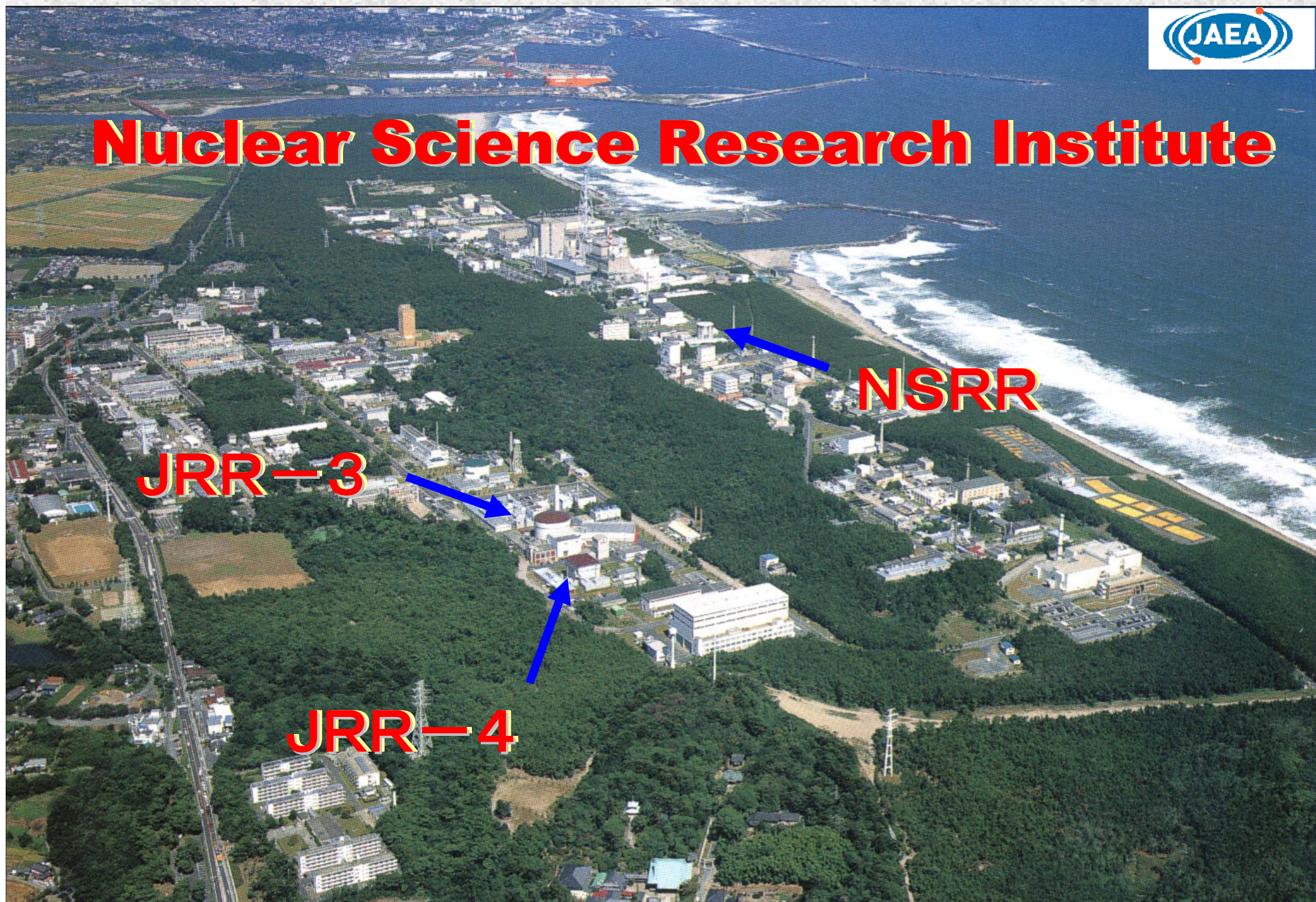
NSRR

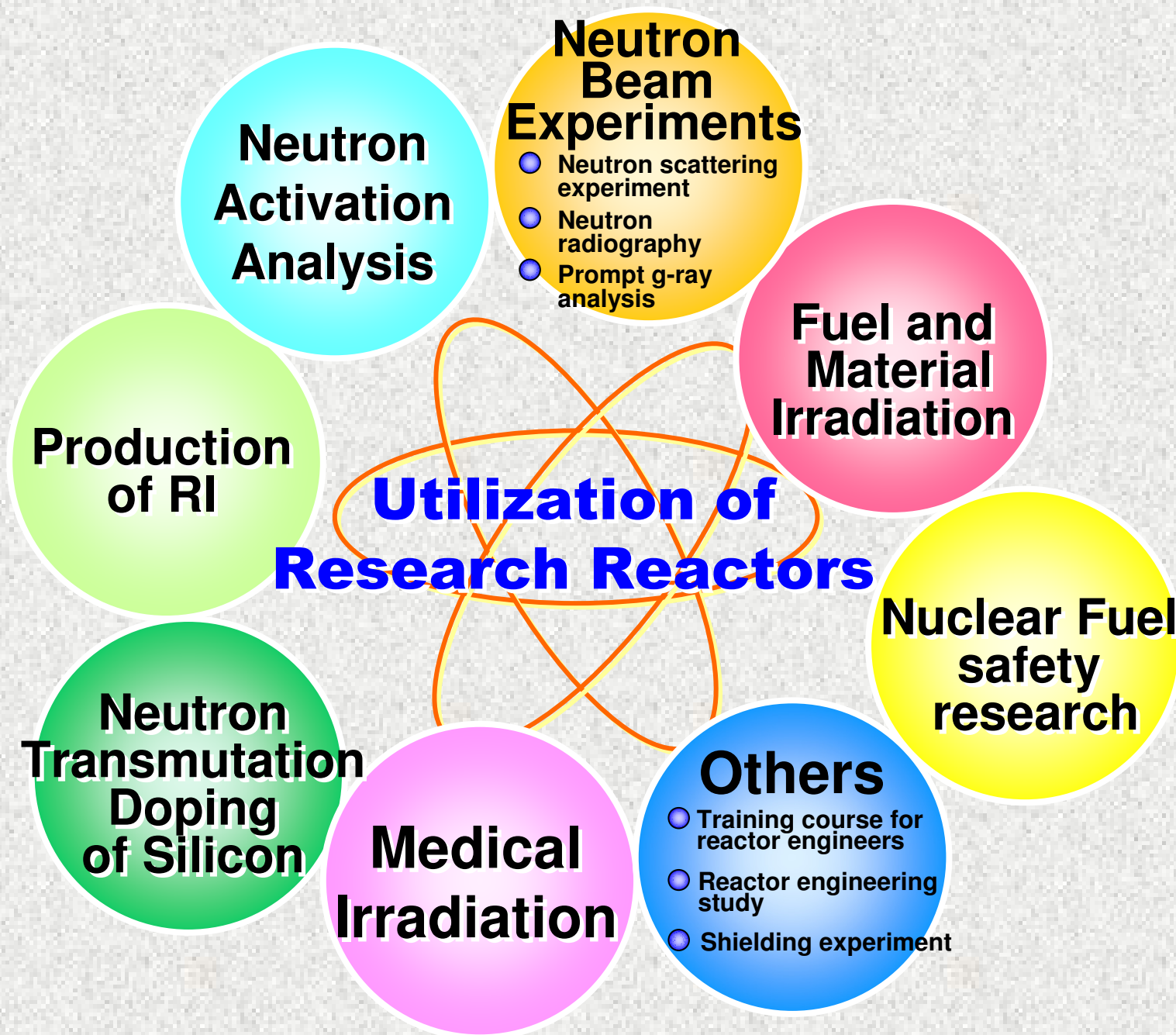
Nuclear Science Research Institute

JRR-3

NSRR

JRR-4

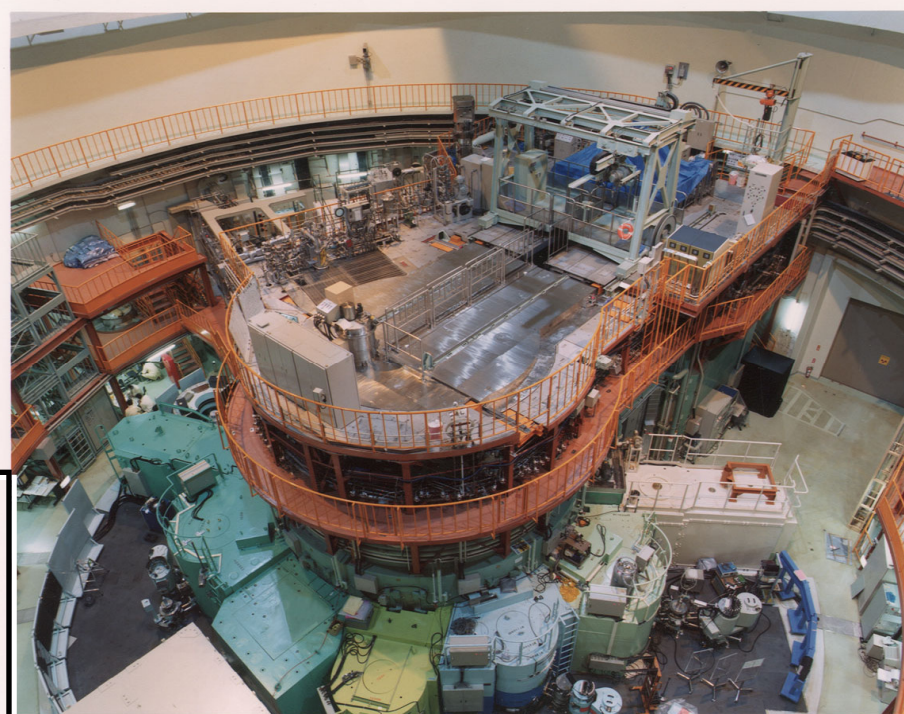




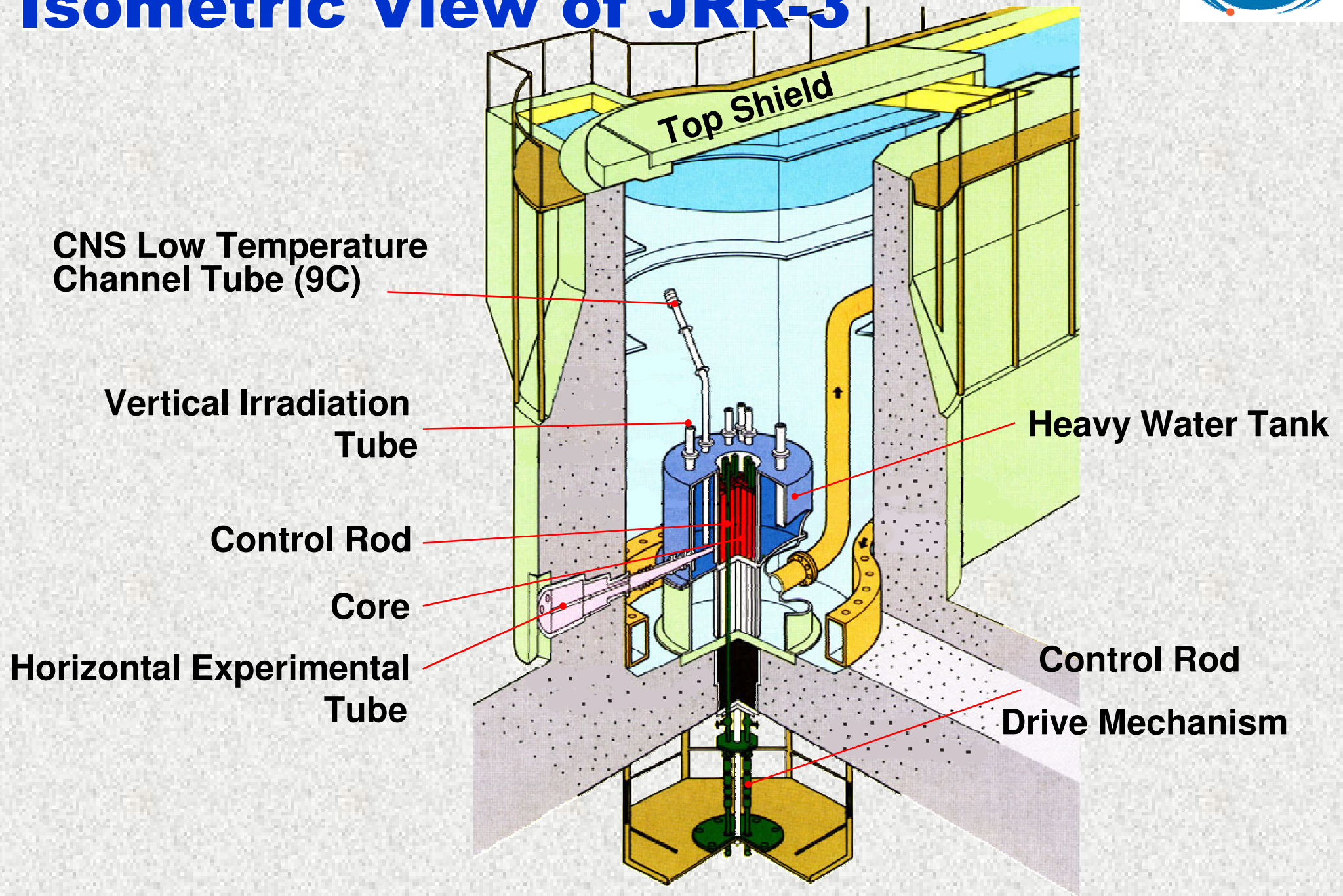
Outline of JRR-3

- **First Critical** :12_{th} September, 1962
22_{nd} March, 1990(**Upgraded**)
- **Purpose** :Beam experiments, Irradiation tests, RI production, Activation analysis, Silicon semiconductor
- **Type** :Light water moderated and cooled, pool type reactor with low-enriched uranium
- **Max. Thermal Power** : 20MW
- **Max. Thermal Neutron Flux** :
Approx. $3 \times 10^{18} \text{ m}^{-2} \text{ s}^{-1}$
- **Operation Mode** :
Cycle Operation, 26 days/Cy
6~7cycle Operation/year

American Nuclear Society
Nuclear Historic Landmark Award
August 2007



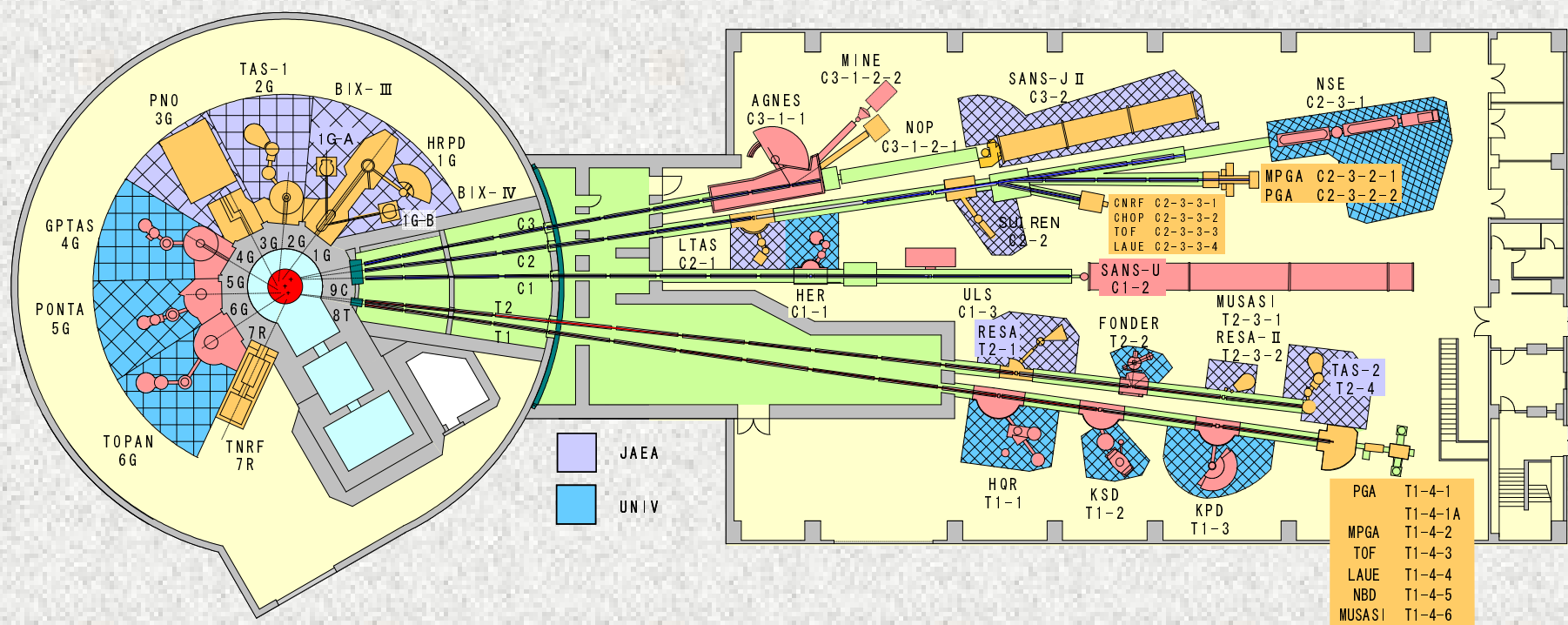
Isometric View of JRR-3



Layout of neutron beam experimental instruments at JRR-3

Reactor Building

Experimental Building

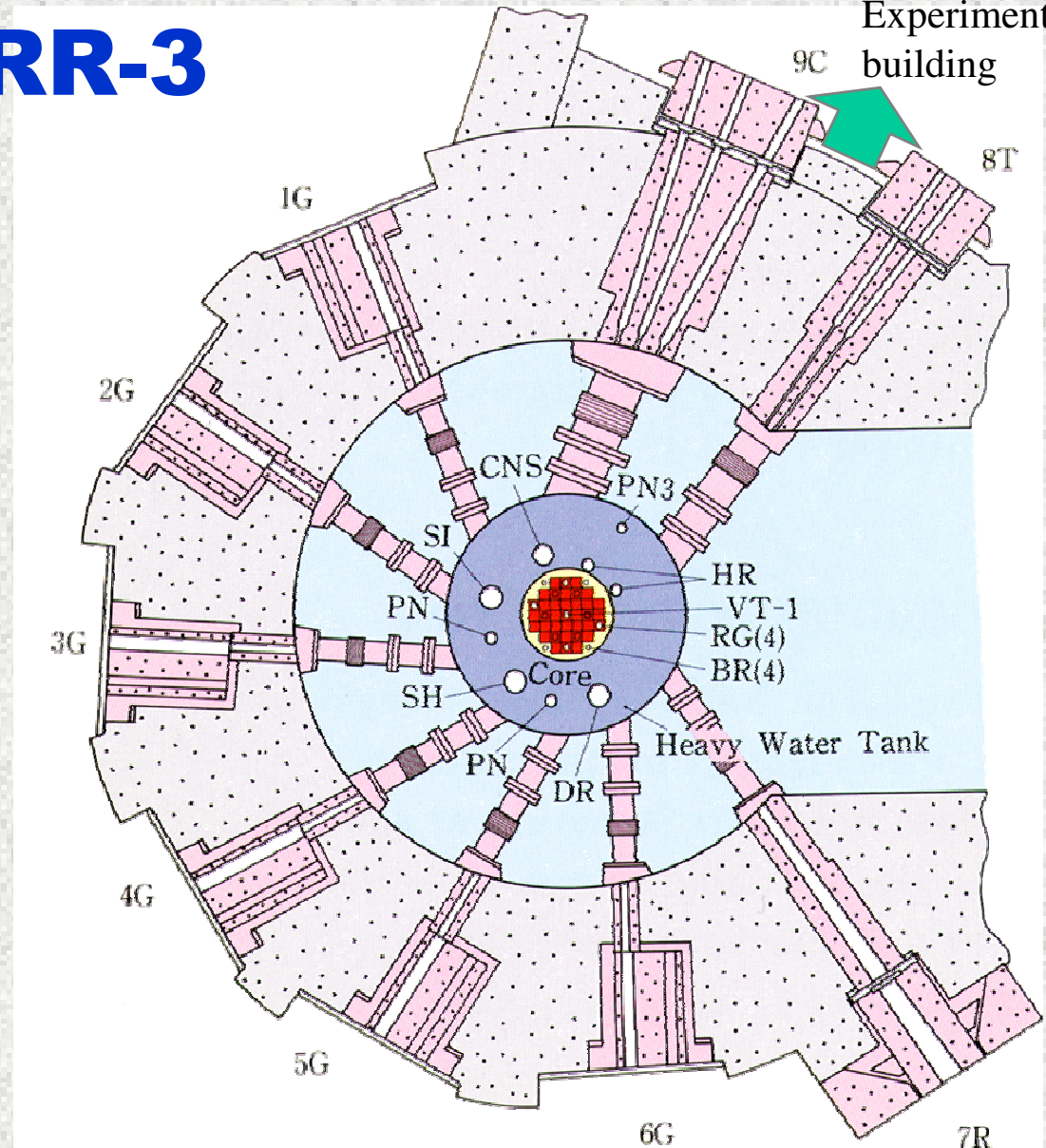


Beam Experimental Facilities of JRR-3



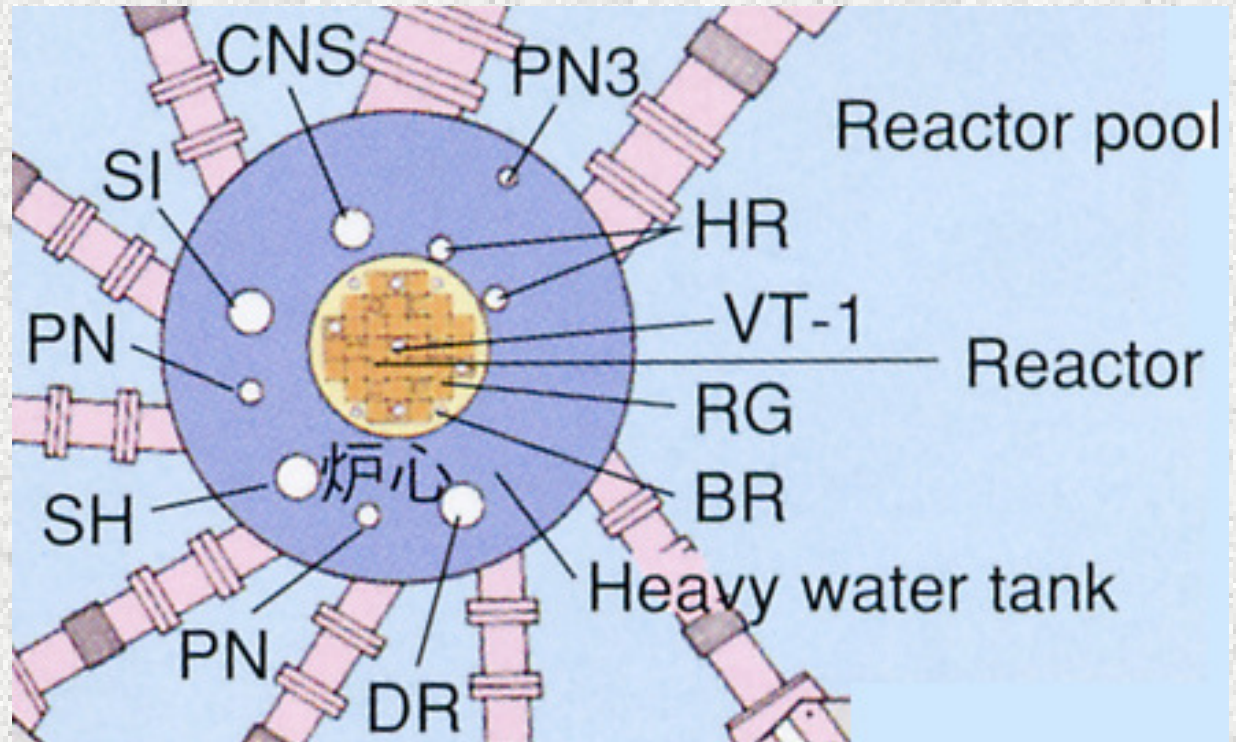
Experimental
building

- 1G – 6G : For neutron scattering experiments, etc
- 7R : For neutron radiography
- 8T : For various experiments by using thermal neutrons
- 9C : For various experiments by using cold neutrons



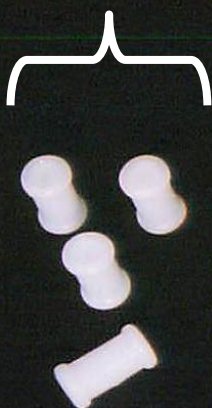
Irradiation Utilization Facilities of JRR-3

- Irradiation facilities
 - Hydraulic rabbit (HR)
 - Pneumatic rabbit (PN)
 - Activation analysis (PN3)
 - Uniform (SI)
 - Rotating (DR)
 - Capsule (RG, BR, VT-1, SH)

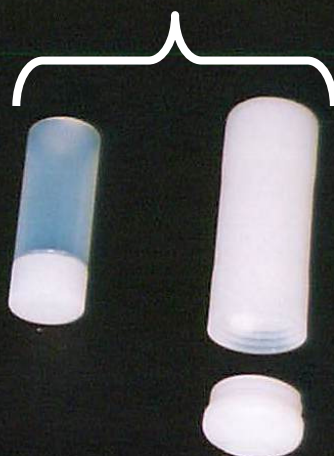


JRR-3 irradiation capsules

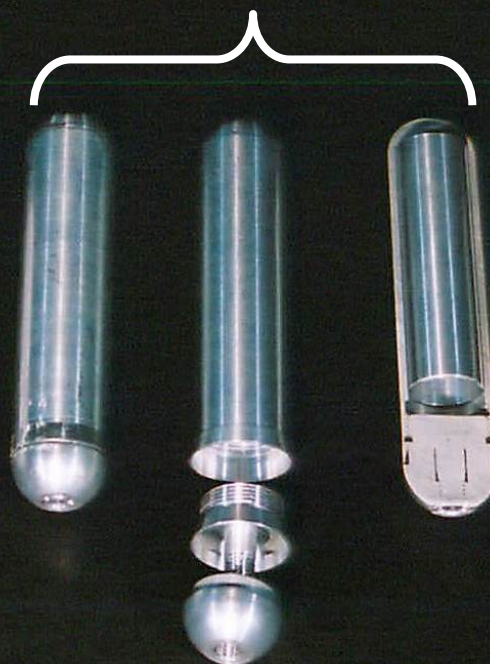
Capsules
for PN-3



Capsules
for PN-1
and 2



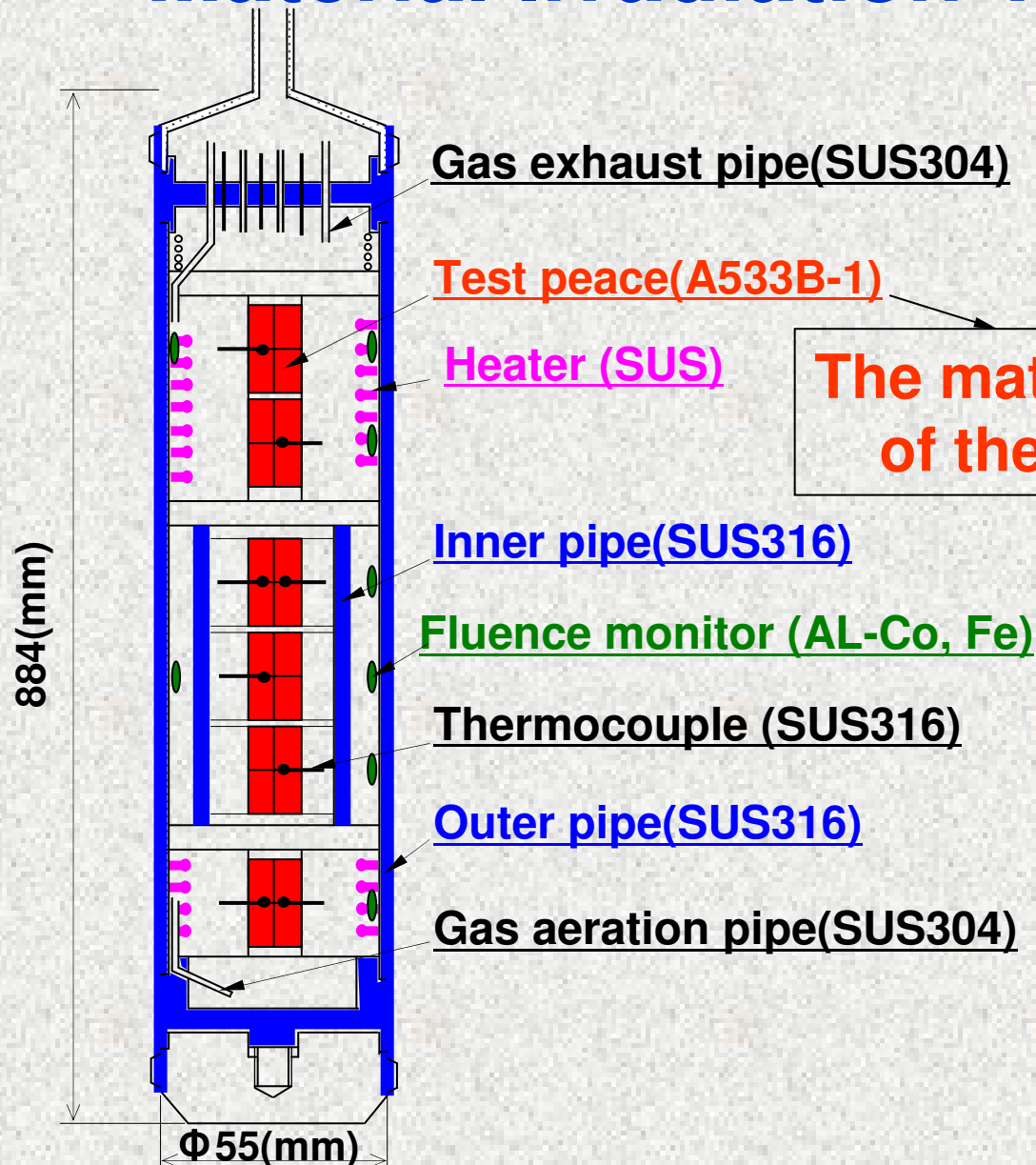
Capsules
for HR-1
and 2



Capsules
for vertical
irradiation



Temperature control capsule for Material Irradiation Tests at JRR-3



The material of the pressure vessel of the light water power reactor

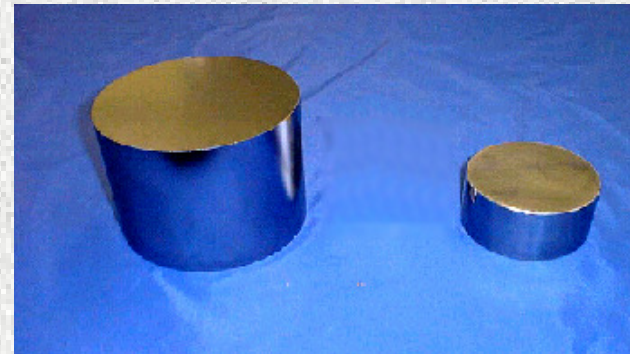
Temperature control

- Gap control
- Heater control
- Mixture gas control (^2N and He)

Production of silicon semiconductors at JRR-3



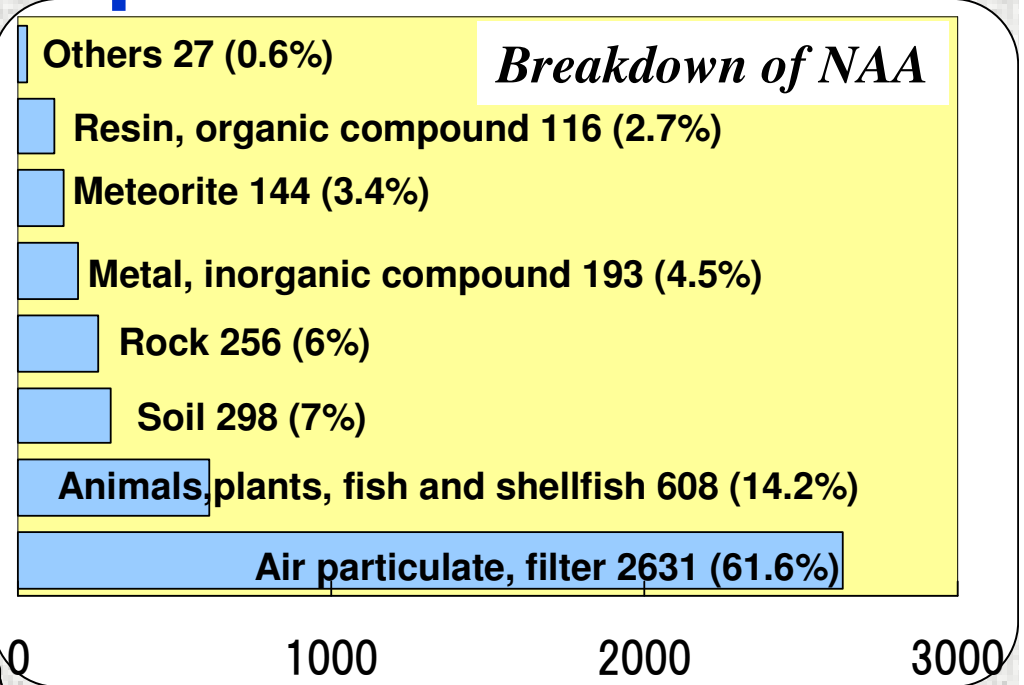
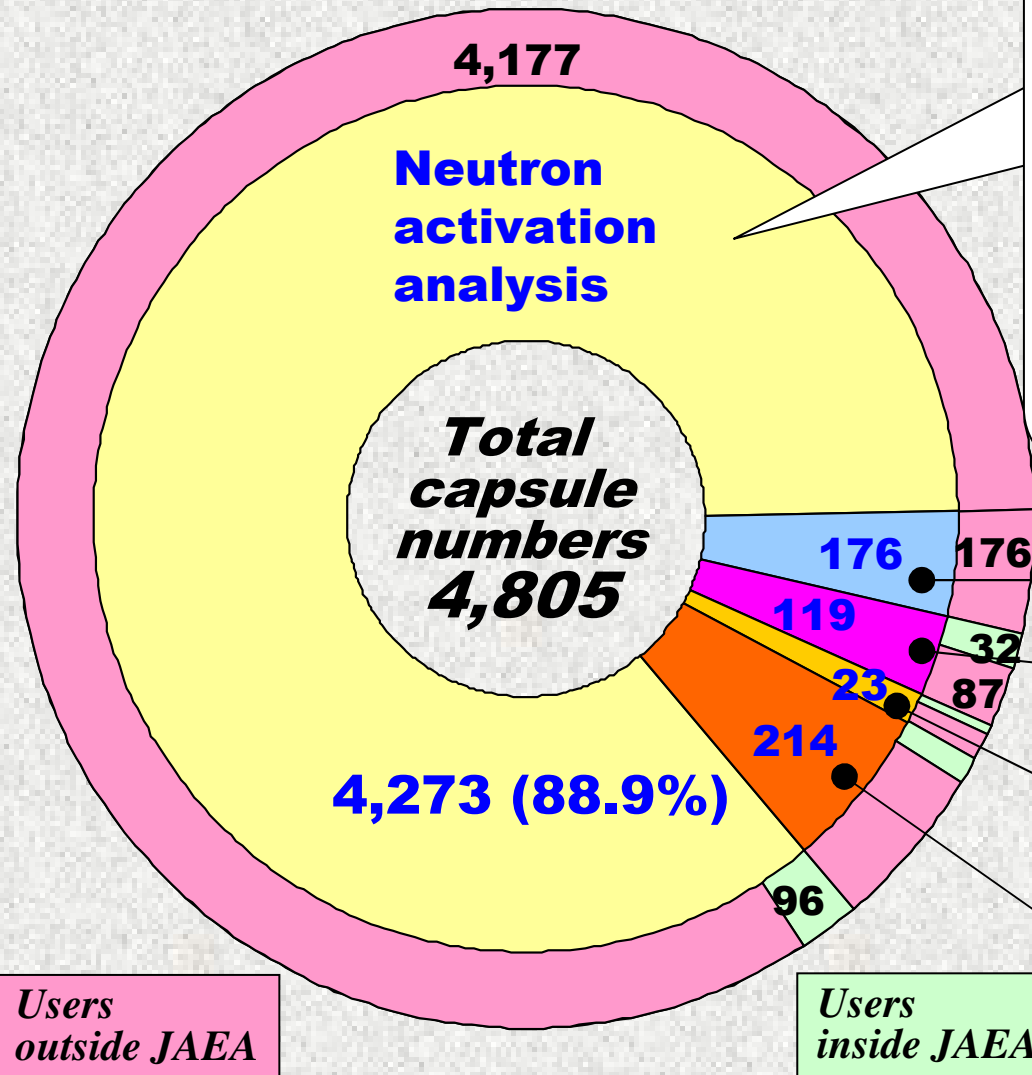
JRR-3 Silicon irradiation device



Silicon single crystal

- **Maximum irradiation size : 6 inch. diameter**
- **Manufacturing capacity : About 3.5 ton/year**

Status of utilization of capsules irradiated in JFY 2008(JRR-3)

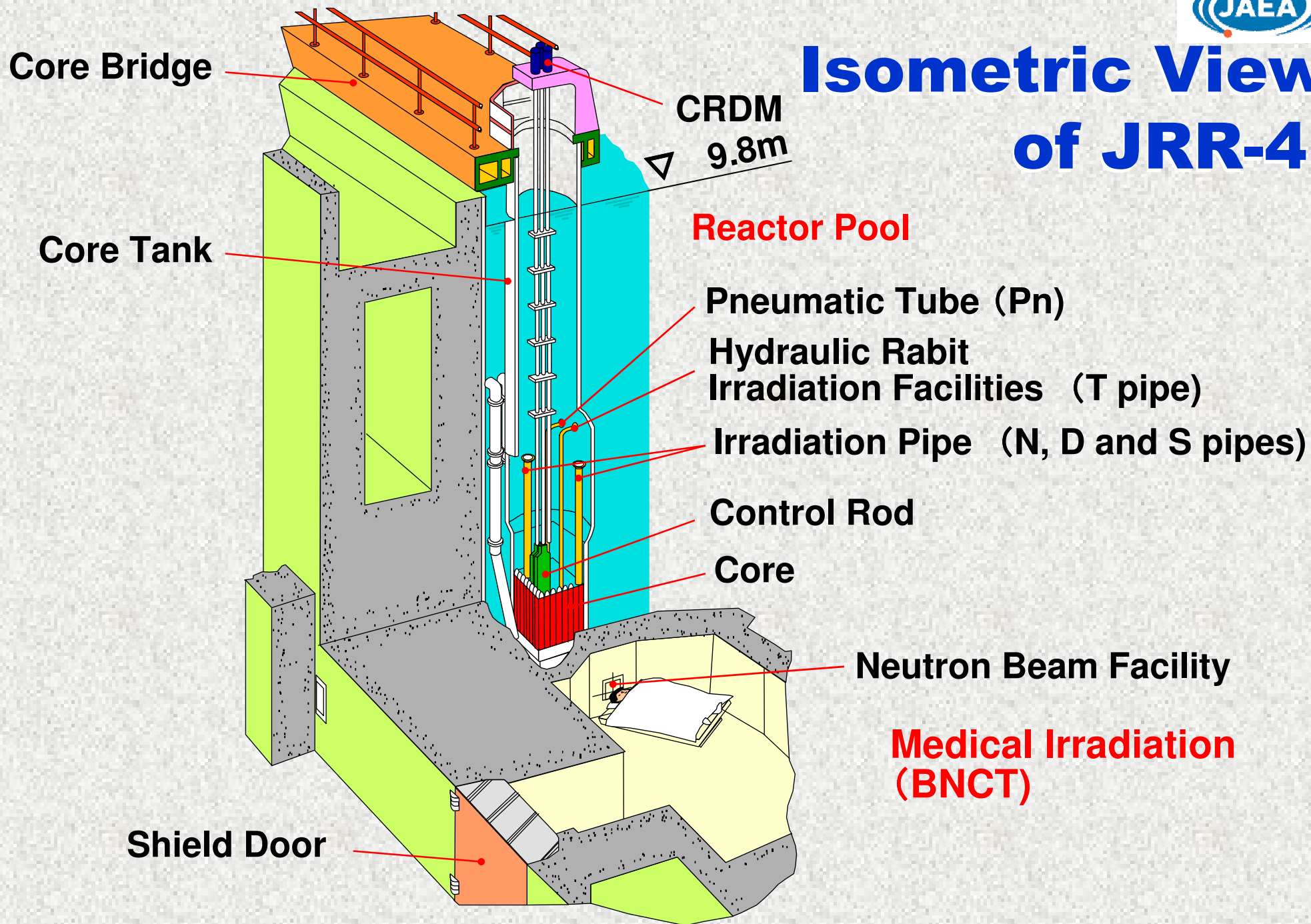


Outline of JRR-4

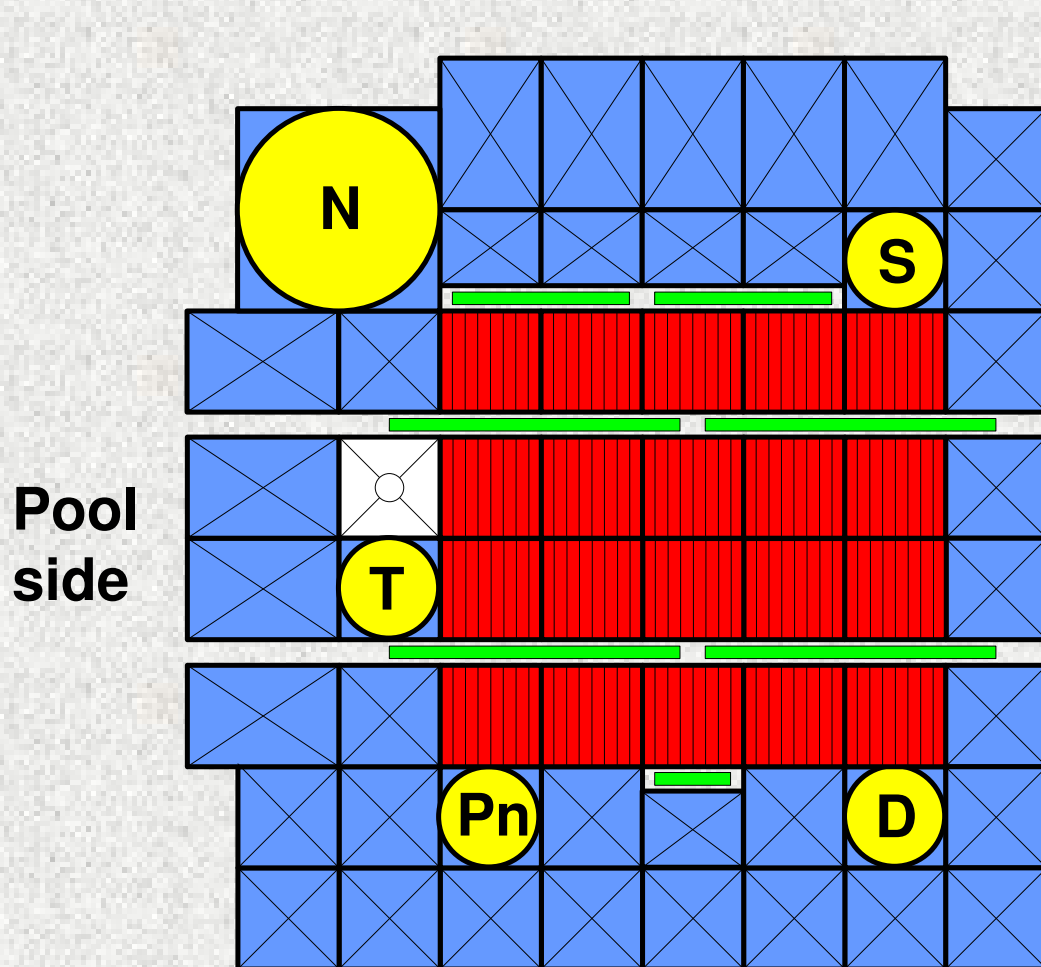
- **First Critical :** 28th January, 1965
14nd July, 1998 (Low Enriched)
- **Purpose :** Medical Irradiation (BNCT), RI production, Activation analysis, Education and Training
- **Type :** Light water moderated and cooled, swimming pool type reactor
- **Max. Thermal Power :** 3.5MW
- **Max. Thermal Neutron Flux:** approx. $7 \times 10^{17} \text{ m}^{-2} \text{ s}^{-1}$
- **Operation Mode :**
Daily Operation,
6hrs/Day






Isometric View of JRR-4



Reactor core of JRR-4



-  Fuel elements
-  Control rods
-  Reflector elements

 Neutron source

 Irradiation tubes

D : D Pipe

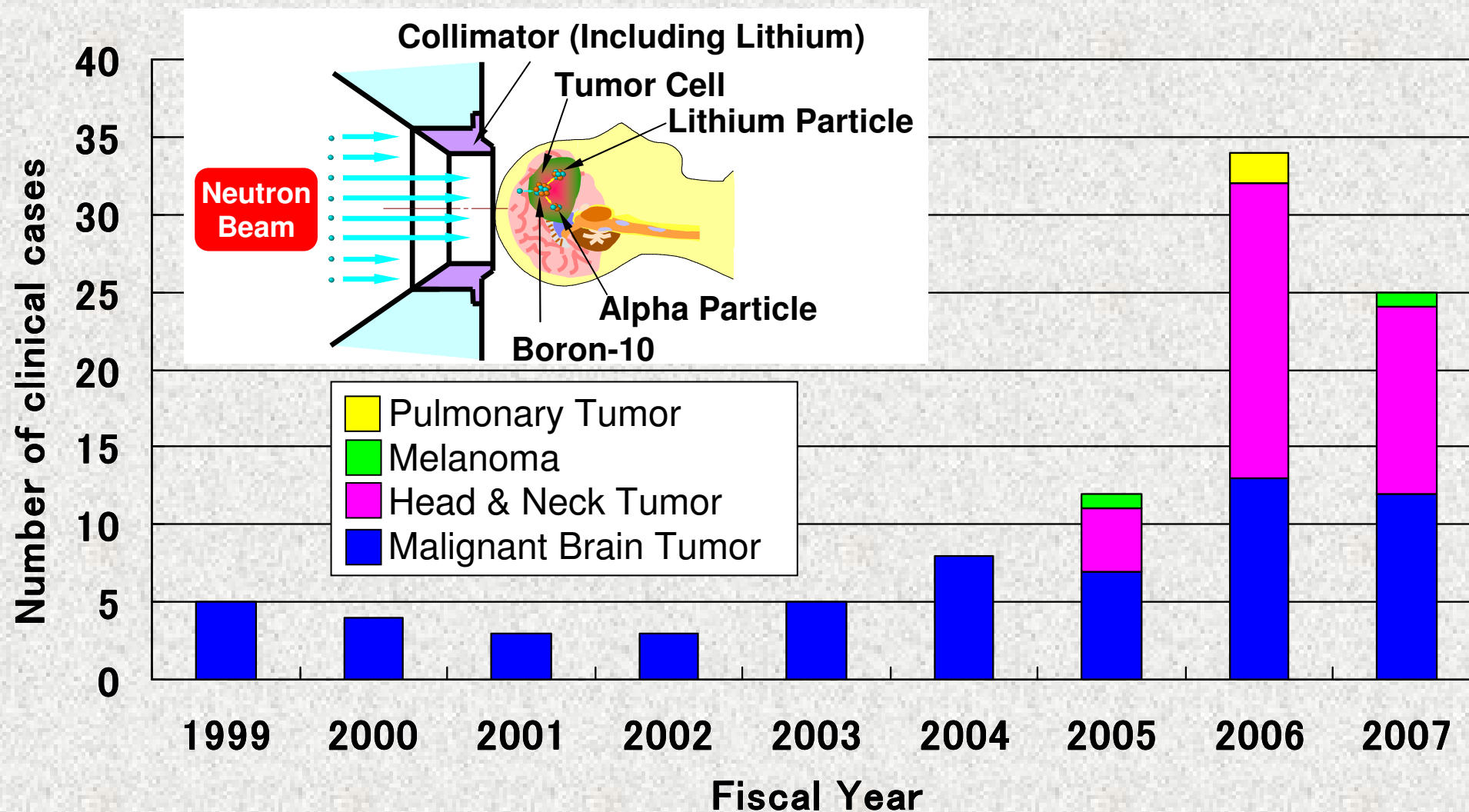
T : T Pipe

N : N Pipe

Pn : Pneumatic tube

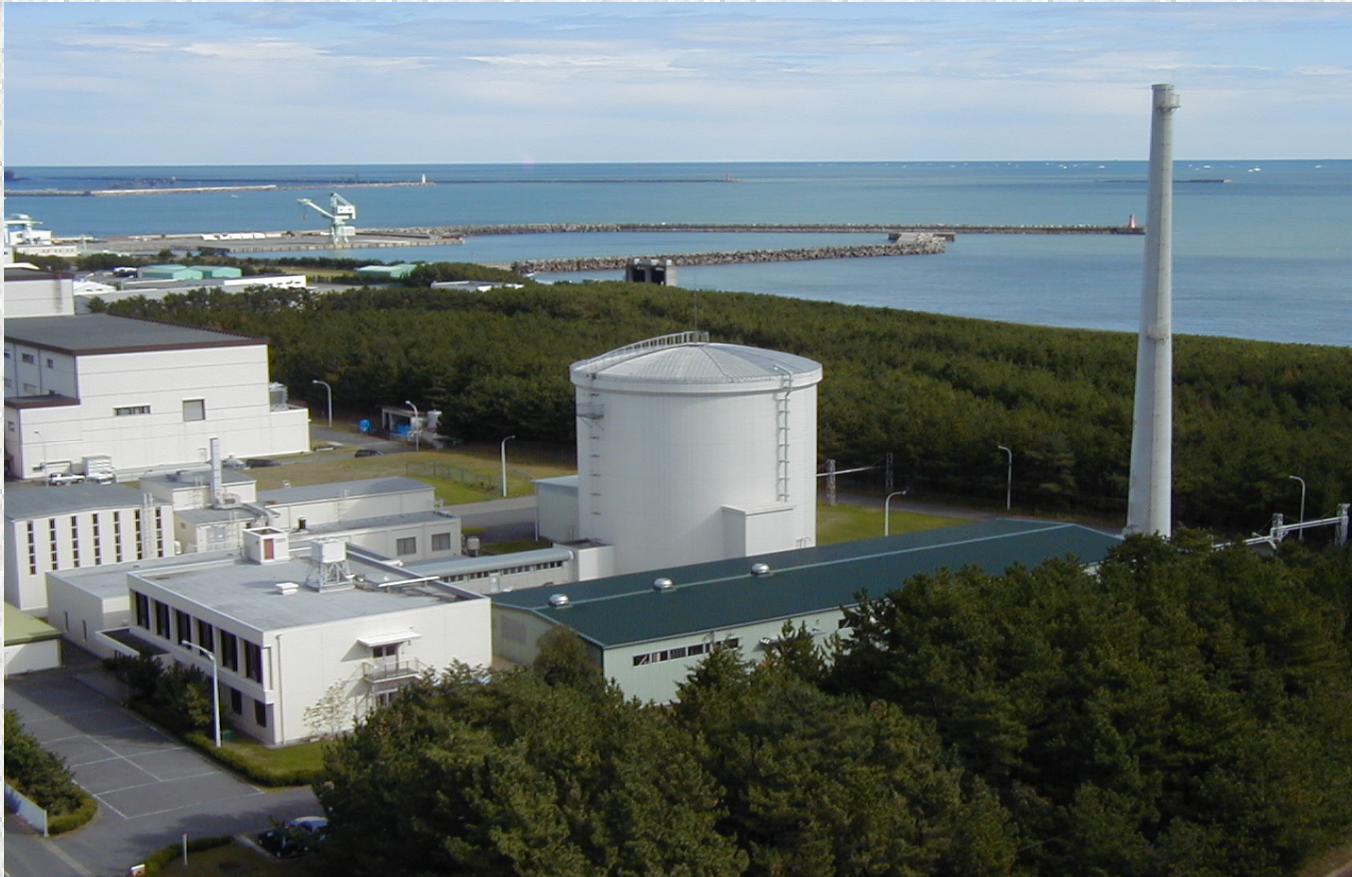
S : S Pipe

Changes in number of clinical cases of BNCT at JRR-4

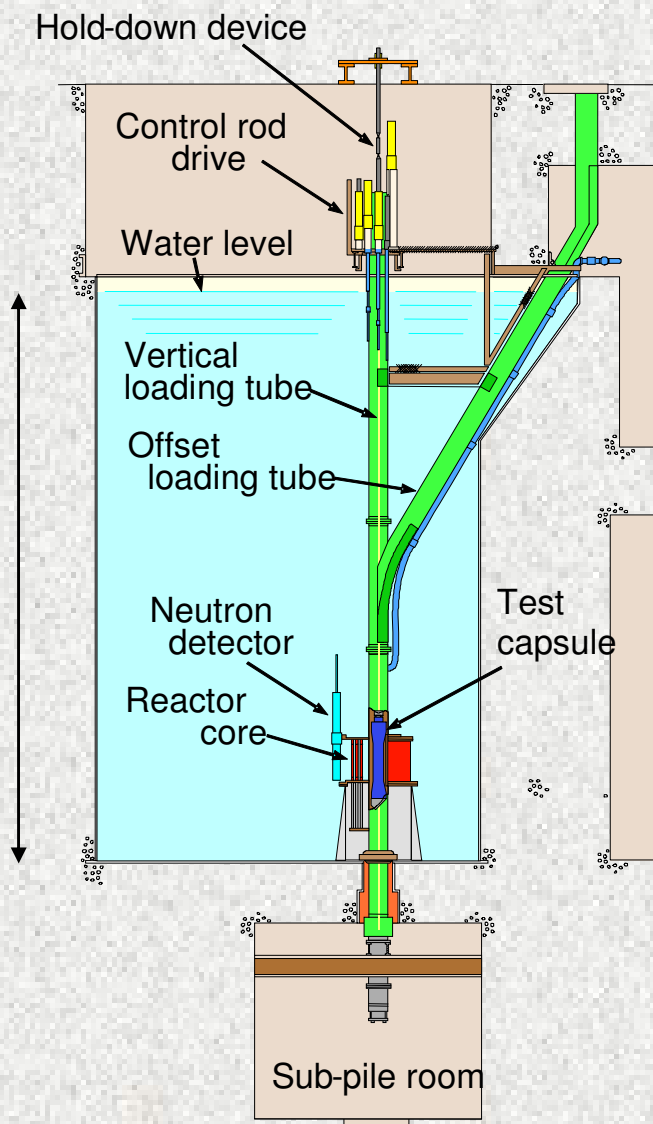


Outline of NSRR

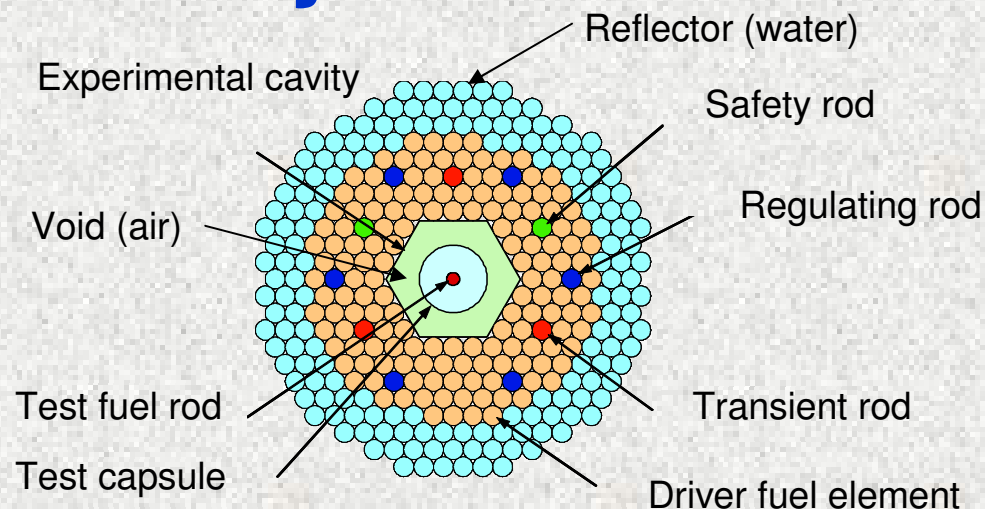
- **First Critical :** June, 1975
- **Max. Reactor Power :** 23GW(Pulse operation)



NSRR facility



Vertical Cross section of the NSRR



Core horizontal cross section

Reactor core

Effective height: ~38 cm

Equivalent diameter: ~60 cm

Moderator: $\text{ZrH}_{1.6}$, H_2O

Driver fuel rod

Fuel materials: $\text{U-ZrH}_{1.6}$

Enrichment: 20%

Cladding: SUS 304

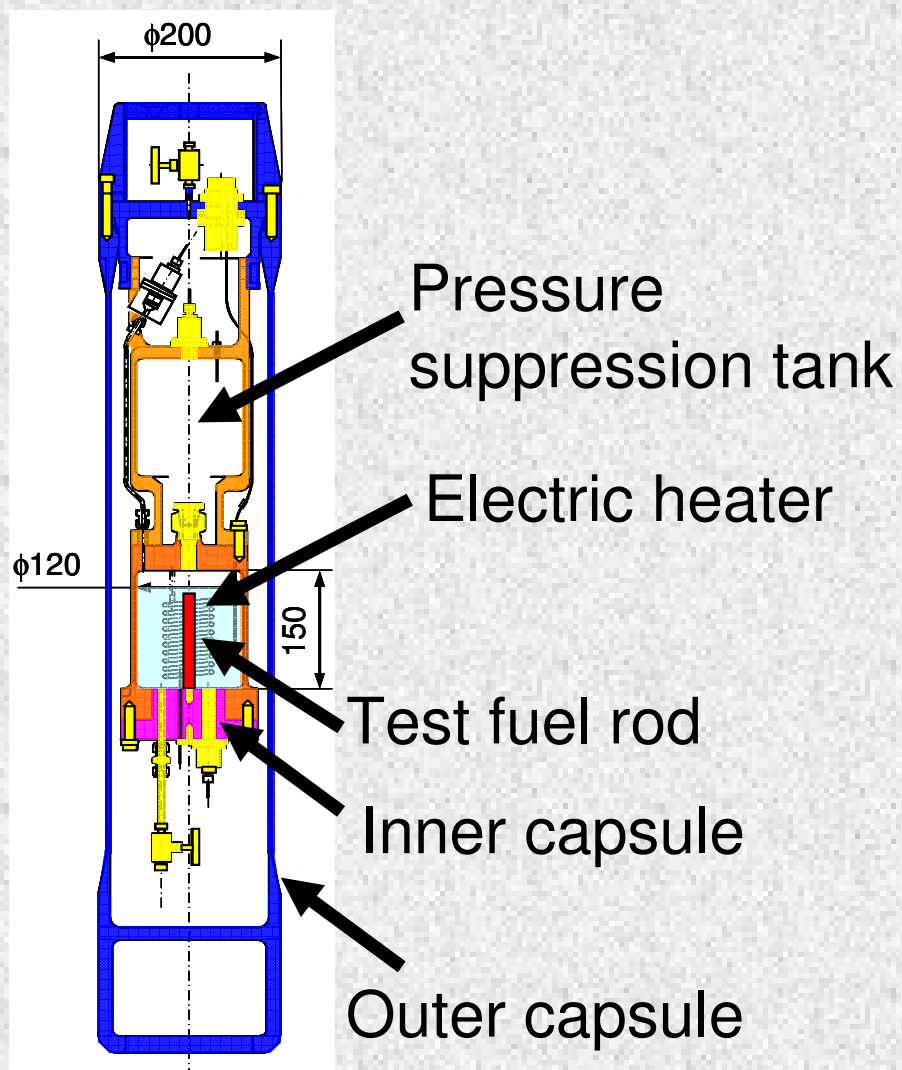
Dimensions: 3.75cmD x 60cmL

Number of rods: 157

NSRR Experiment

- Fresh fuel experiments
(1975~)
- Irradiated fuel experiments
(1989~)
- High burnup fuel/ MOX fuel experiments
(2002~)

High burnup fuel/ MOX fuel experiments (2002~)



High temperature capsule

Test fuel

- UO_2
- MOX

Test condition

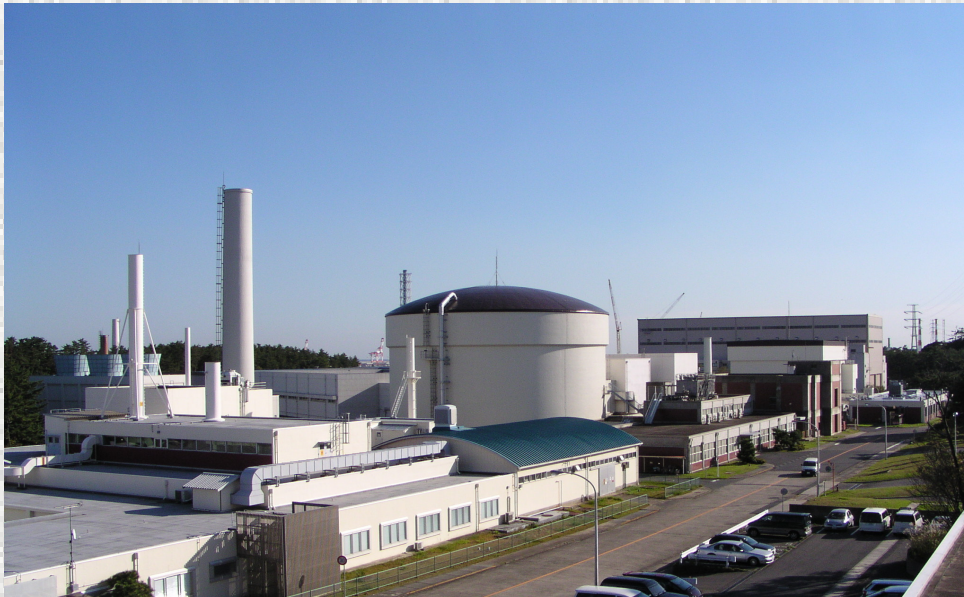
- temperature: 286°C
- pressure: 7.12Mpa

REMARK

JRR-3 was utilized capsule irradiation of 4,805 samples, for neutron activation analyses, neutron transmutation doping of silicon, etc in JFY 2008.

Boron neutron capture therapy was carried out 25 times using JRR-4 in JFY 2007. The trouble of reflector occurred in December 2007. At present, the reactor has been stopped to replace the reflector.

A new capsule of NSRR which achieves high temperature condition was developed successfully.



Thank you for your attention

